

*Sand Storms.*—Ft. Garland, Col., 12th, (13th violent). Umatilla, Or., 5th, most violent; maximum velocity, 62 miles W. at 12 and 12.30 p. m., accompanied with electricity so intense that it was impossible to touch anemometer wire or battery without experiencing severe shock; 25th, very violent and accompanied with much electricity. Las Cruces, N. M., 26th; Davis, Tex., 27th; Ft. Yuma, 7th, 25th.

## VERIFICATIONS.

*Indications.*—The detailed comparison of the tri-daily indications for March, with the telegraphic reports for the succeeding twenty-four hours, shows the general percentage of verifications to be 85.4 per cent. The percentages for the four elements are: Weather, 87.1; Direction of the Wind, 82.1; Temperature, 86.0; Barometer, 86.1 per cent. By geographical districts they are: for New England, 85.5; Middle States, 86.6; South Atlantic States, 87.0; Eastern Gulf States, 84.4; Western Gulf States, 79.4; Lower Lake region, 87.3; Upper Lake region, 87.1; Tennessee and the Ohio valley, 83.7; Upper Mississippi valley, 85.6; Lower Missouri valley, 87.2; Northern Pacific region, 77.5; Central Pacific coast region, 87.5; Southern Pacific coast region, 88.3. There were 14 omissions to predict out of 3,813, or 0.37 per cent. Of the 3,799 predictions that have been made, 137, or 3.60 per cent, are considered to have entirely failed; 109, or 2.87 per cent, were one-fourth verified; 443, or 11.66 per cent, were one-half verified; 463, or 12.19 per cent, were three-fourths verified; 2,647, or 69.68 per cent, were fully verified, so far as can be ascertained from the tri-daily weather maps.

*Cautionary Signals.*—260 Cautionary Signals were displayed during the month, of which 225, or 86.5 per cent., were justified by winds of 25 miles per hour or over at, or within a radius of 100 miles of the station: 94 Off-shore Signals were displayed, of which 85, or 90.4 per cent, were fully justified; 90, or 95.7 per cent, were justified as to direction; 86, or 91.5 per cent as to velocity; and 3, or 3.2 per cent, were not justified either as to direction or velocity. 52 of the Off-shore were changed from Cautionary. 354 Signals of both kinds were displayed, of which 310, or 87.6 per cent, were fully justified. The above does not include signals ordered for 50 display stations, where the velocity is only estimated. 67 cases of winds of 25 miles and over per hour, from scattering stations, were reported, and for which signals had not been ordered.

## NAVIGATION.

In the table on the right-hand side of chart No. III are given the highest and lowest readings of the Signal Service river gauges for the month, with the dates of the same. The *Red River* at Shreveport rose gradually during the month from about 10 feet on the 1st to nearly 23 feet on the 31st. The *Arkansas* at Little Rock rose 4 feet from the 2nd to the 11th, remained almost stationary until the 17th, then fell to end of month. The *Missouri* varied but little throughout the month, the total range at the three stations, Yankton, Omaha and Leavenworth, being from 3 to 4 feet; above Yankton it continued frozen until the latter part of the month—see notes on ice given below. The *Mississippi* remained closed at St. Paul until the 29th; from La Crosse to St. Paul the total range did not exceed 4 feet; at Cairo the water fell slowly from 1st to 6th, it then rose slowly, and, passing the danger-line (40 feet) on the 9th, reached 44 feet 7 inches from the 21st to the 25th, after which it slowly fell and passing the danger-line on the 30th reached 38 feet 11 inches on the 31st; at Memphis the water continued almost stationary and within a few inches of danger-line (34 feet) from the 1st to the 18th when it passed the danger-line and continued a few inches above that point to the end of month, the total monthly range being only 17 inches; at Vicksburg the water rose slowly from the 2nd, and passing the danger-line (41 feet) on the 11th, reached 42 feet 11 inches on the 31st; at New Orleans it rose slowly from the 18th, and, passing the danger-line on the 10th, reached the maximum height, 13 inches above the danger-line, on the 28th. Notwithstanding the long continued high stage of water from Cairo to New Orleans the amount of damage reported was comparatively small; the principal crevasses reported were (1) above Arkansas City, flooding town and adjoining plantations, (2) near Gaines' Landing, flooding the Yellow Bayou country, and (3) in Bayou La Fourche, near Lockport, causing little damage. The most damage probably occurred at Cairo, where one-fourth of the city grounds were overflowed 3 to 5 feet by "snipe" water. The *Ohio* at Pittsburg, fell from 9 ft. 5 in. on the 1st, to 6 ft. 9 in. on the 4th, rose to 14 ft. on the 6th, fell to 6 ft. 6 in. on the 14th, rose to 10 ft. 9 in. on the 17th, fell to 5 ft. on the 27th, rose to 9 ft. 6 in. on the 29th and fell to 8 ft. 3 in. by end of month; at Cincinnati the water continued almost stationary, (at about 28 ft.) until the 6th, when a rapid rise set in reaching 44 ft. 9 in. on the 10; on the 12th the water commenced falling and reached 21 ft. 11 in. on the 26th, after which it rose slowly to end of month; at Louisville a rise of 8 ft. occurred from the 8th to 12th, and the water remained comparatively high until the 20th, after which it fell to 8 ft. 8 in. on the 28th. The *Tennessee* at Chattanooga generally rose from the beginning of the month to the 18th, when the water reached 37 ft. 7 in. or 4 ft. 7 in. above danger-line, after which it fell, passing the danger-line (33 ft.) on the 20th and reaching 7 ft. 2 in. on the 31st; on the 19th the low lands near the city were overflowed. The *Cumberland* at Nashville rose from 34 ft. on the 1st to 40 ft. on the 4th; fell to 32 ft. on the 7th, after which it rose and passing the danger-line, (42 ft.) on the 12th reached 46 ft. 6 in. on the 17th; it remained almost stationary at this high stage until the 20th, after which it fell rapidly, and on the 31st reached 11 ft.; portions of the city were flooded and houses had to be vacated. The *Savannah* at Augusta remained almost stationary until the 9th, when a rapid rise set in; on the 17th the water reached the highest stage, (28 ft. 5 in.,) after which it fell to 9 ft. at end of month. The *Alabama* at Montgomery, from the 15th to the 20th, overflowed

low lands and the *Chattahoochee* at Gainesville, Ga., on the 16th, overflowed, causing much damage to crops, fences and bridges. Since printing the table of heights of rivers on chart No. III the reports received from Portland, Oregon, give the height of water in the Columbia river: highest, 3rd, 5 ft. 6 in.; lowest, 22nd and 23rd, 1 ft. 4 in.

*Ice in Rivers and Harbors.*—The following notes on the breaking up of ice, &c., and opening of navigation are reported by observers: *Yellowstone River.*—Fort Keogh, Mont., 23rd, ice broke up. Fort Buford, 24th, ditto. *Missouri River.*—At Fort Buford, Dak. T., the river below the mouth of the Yellowstone broke up on the 26th and above on the 28th. Fort Stevenson, ice broke up on the 29th, Bismarck, 30th, Fort Yates, 30th, 1:30 p. m. Omaha, ice disappeared on the 20th. Plattsmouth, river open on the 2nd, closed on the 14th, and open again on the 20th. *Dakota River.*—Morrison, ice disappeared on the 25th. *Mississippi River.*—St. Paul, ice broke up on the 26th, but remained gorged until the 29th. La Crosse, 6th, river open; 14th to 18th, river frozen above city; 12th, first steamboat arrived from below. Davenport, 1st to 18th, floating ice. Keokuk, from 1st to 17th, floating ice. Burlington, 17th, river clear of ice. *Rock River.*—Rockford, Ill., 14th and 15th, frozen over. *Des Moines Rapids Canal.*—8th, open. *Lake Superior.*—Duluth, harbor closed entire month; 31st, the ice was two feet thick and extended out about thirty miles. Marquette, 24th, the ice in the bay over two feet thick. *Lake Huron.*—Alpena, 8th, steamer left port, but had to return, and was ice-bound until the 23rd; river frozen until the 30th. Port Huron, 18th, first boat from Toledo. *Lake Michigan.*—At Escanaba navigation closed: bay frozen throughout month. At Northport the bay continues low; navigation opened on the 31st. Milwaukee, 13th and 14th, ice around pier. *Detroit River.*—Detroit, first steamer left on the 9th: 13th to 19th, river full of floating ice. *Lake Erie.*—Toledo, coasting scows running on the 2nd; first steamers and schooners left on the 13th. Buffalo, 19th, first vessels arrived. Sandusky, 8th, first vessel left port. Cleveland, 9th, first steamer arrived. *Lake Ontario.*—Rochester, 23rd, first vessel arrived; Oswego, 21st, ditto. Catawissa, Pa., 17th, North Branch of Pennsylvania canal opened for navigation. *Otsego Lake.*—Cooperstown, N. Y., lake open on the 5th, but closed again on the 9th. *Hudson River,* Albany, 1st, river open to New York; 10th, first steamer left for New York. *Lake Champlain.*—Burlington, 6th, lake open; 23rd, temporarily frozen over; 29th, Shelburne Bay, south of city, still closed with heavy ice; 29th, first steamer left for Plattsmouth. *Lake Massachusetts.*—Auburn, N. H., 31st, about half free of ice.

*High Tides.*—Atlantic City, 29th; Portsmouth, N. C., 10th, 29th; Indianola, Tex., 21st, 22nd.

*Low Tides.*—Baltimore, 25th.

## TEMPERATURE OF WATER.

The *temperatures of water* as observed in rivers and harbors, with average depth at which observations were taken, is given in the table on the left side of chart No. II. At the following stations observations were not made on the dates indicated on the account of ice:—Duluth, Escanaba and Marquette throughout the month: Alpena, 1st to 29th; Milwaukee, 13th and 14th; Detroit, 13th to 19th; Burlington, 1st to 7th and 9th to 28th. On account of breakage of thermometer no observations were made at Alpena on 30th and 31st: at Eastport from 10th to 31st; at Milwaukee from 28th to 31st; at New York City, from 1st to 7th and 19th to 25th, and at San Francisco from 1st to 13th.

## ATMOSPHERIC ELECTRICITY.

*Thunder-storms*—were reported in the various districts as follows: New England, 5th; Middle Atlantic States, 4th, 5th, 22nd, 23rd, 26th to 28th; South Atlantic States, 5th, 6th, 13th to 16th, 18th, 27th, 28th; Gulf States, 8th to 16th, 18th, 19th, 27th, 28th, 31st; Tennessee and the Ohio valley, 3rd to 6th, 11th, 12th, 16th, 23rd, 25th to 29th, 31st; Lake region, 3rd to 5th, 27th; Upper Mississippi and Lower Missouri valleys, 2nd to 6th, 25th to 27th, 31st; California, 3rd at Sacramento and Visalia, 14th at San Diego.

*Auroras.*—Isolated cases of aurora are reported as follows: 1st, Pembina, Dak.; 3rd, Oregon, Mo.; 8th, Nora Springs, Iowa; Manitowoc, Wis., 9th, 10th, dark segment with "merry dancers;" 9th and 21st, Frankfort, Mo.; 16th, Starkey, N. Y.; 10th, Orono, Me.; 15th, Ft. Stevenson, Dak., ranging from 60° N. to 60° W.; the beams had a quick lateral motion and were most brilliant about 3 a. m. of the 16th; the beams displayed the greatest brilliancy and altitude when due north, sometimes reaching the zenith; 16th, aurora similar to the 15th though not so brilliant; Ft. Sisseton, Dak., 21st, 8 to 11 p. m.; Williamstown, Mass., 30th. On the 12th at Burlington, Vt., 11:15 p. m., and Eastport, Me., 11:45 p. m.; color, pale yellow, few streamers, no dark segment. Starkey, N. Y., 8 p. m. On the 13th an aurora was observed from Eastport, Me., to Ft. Sisseton, Dak., except where cloudy weather prevented observations. The following descriptions are reported: At Eastport, Me., faint, and of pale yellow color; it began at 11:45 p. m. of the 13th, and ended at 3:00 a. m. of the 14th. At Burlington, Vt., seen for a few minutes through a rift in clouds, and was observed to be faint. Pembina, Dak., "very brilliant aurora at 7 p. m. of the 13th, and continued into the night. The whole northern sky was more or less illumined and the light emitted was almost equal to the moon at the full. A broad arch of light, very bright but rather ill-defined, extended 170° to 270° azimuth, and sometimes reached the zenith. There was a good deal of movement, but it was rather slow and the eye had some difficulty in detecting it. There was also some striated lines of light crossing the arch but nothing like "merry dancers." A peculiarity of this aurora was a number of large whorls of nebulous light, like the large nebula in Canes Venatici, which appeared at several points along